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UNITED STATES DEPARTMENT OF AGRICULTURE

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JOHN R. MOHLER, Chief

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REQUIREMENTS AND COST OF PRODUCING MARKET MILK IN NORTHWESTERN INDIANA.[1]

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CHARACTER AND SCOPE OF THE WORK.

In order to determine the requirements of milk production, to isolate and analyze the various factors so that methods could be recommended for reducing the cost of production, and to obtain data which would aid in improving general milk-production methods, the United States Department of Agriculture, through the Dairy Division of the Bureau of Animal Industry, began a series of studies in 1915. Since the intention of the department was to make these studies as thorough as possible, it was decided that the first step would be to obtain accurate data concerning the requirements for producing milk by practical dairy farmers in market-milk centers of the United States. Accordingly projects were organized to obtain detailed records on groups of dairies in various market-milk sections.

[1] The work was carried on in northwestern Indiana in cooperation with the Purdue University Agricultural Extension Department, and applies especially to milk supplied from that section for the Chicago market.

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THE INDIANA PROJECT.

The project with which this publication deals was organized in Porter County, Ind., in cooperation with the Purdue University Agricultural Extension Department. The work was begun in August, 1915, and was continued for 2 years. The specialist employed by the two departments made monthly visits from September, 1915, to September, 1917, to each of a group of dairy farms in the northwestern part of the State. This section was selected because the milk from most of the farms in that vicinity was shipped and sold as market milk. All the farms included in this report were approximately 40 miles from Chicago and near-by cities. The many railroads running into Chicago through this territory afforded convenient shipping facilities.

The dairies were representative of dairy-farming conditions in that locality. Dairies conducted as hobbies or as breeding establishments were not included in the study, and with one exception the herds selected were owned or handled by resident farmers, many of whom lived on rented farms.

Although the figures obtained show what was required to produce market milk under the system of dairy management found in the section studied, and probably approximate the requirements in similar sections, they of course do not apply to dairying in other sections where other conditions and methods of management prevail.

The Chicago board of health inspected the dairies shipping milk to that city, and the equipment and methods used in the production and handling of the milk were subject to its supervision. Thus the figures given in this publication represent the requirements for producing milk in that section of Indiana for the Chicago market. The cost of production would have been somewhat different if either higher or lower grades of milk had been produced.

METHODS USED IN OBTAINING THE DATA.

The data obtained in this study are actual records obtained by regular visits of one day a month to 12 farms for 2 years and to 13 other farms for 1 year. The specialist recorded in detail all available information relative to the dairy business, including the amounts and classes of labor, feed and bedding used, the pasture cost, the amount of milk sold and that used on the farm, and the current expenses for the month. Accurate data on calves and first-hand information on methods of handling manure were systematically collected.

By obtaining records on every dairy regularly each month, the influence of unusual circumstances at the time of any particular visit was lessened, and by using the records of all the herds for each month average figures could be compiled for all the dairies and

representative data for each month, season, and year thus secured. Records were obtained the second year as a check on the first year's work and to increase the amount of data available for study.

At the beginning and end of each year the field agent took an inventory of the dairy buildings, livestock, and equipment used in the care of the herd and its products. On his regular monthly inspection tour he arrived at the first farm of a group in time to observe the first labor operations connected with the evening chores. With watch in hand he noted and recorded the exact minute each labor operation connected with the dairy was begun and ended. The labor operations during the next morning were recorded in the same manner.

Account was kept of the feeds that were being fed on the record day, including the kind, amount, cost, and description of each, and these were compared with the amounts recorded by the cow tester in the cow-testing association books.

The quantity of milk sold and receipts each month were obtained. In addition the milk used by the proprietor and his help or fed to calves was measured or weighed and used as a basis for determining the amount kept on the farm during the month.

The dairyman kept an itemized account of expenses which were incurred between the monthly visits, and these items were recorded. A monthly record was kept also of the purchase or sale of cows, calves, hides, outside bull service, and other miscellaneous information relating to the herd. The condition and methods of handling the manure were noted and reported each month.

When all the labor operations about the dairy had been completed for the day at the first farm, the specialist drove to the second farm in time to observe the labor operations connected with the evening chores. This program was followed until Saturday afternoon, when he returned to headquarters and finished his reports for the week's work. The same program was followed each week in the month, and each farm was visited every 30 days throughout the 2 years.

COMPARATIVE SKILL OF MANAGERS.

The comparative value of one dairyman with another, so far as ability to manage is concerned, is directly proportional to his comparative skill in feeding cows economically, managing labor efficiently, conserving the fertilizing value of manure, and producing a large volume of milk at low cost.

The charge for management is separate and distinct from the charge for the physical labor of the manager. Wherever costs are given for human labor they include only hired man's wages for work done by the manager. Therefore, it must be understood that wherever the terms "labor cost," "total cost of production," and

"net cost of production" are used, these terms do not include the charge for managerial ability. If it is desired to include managerial ability as a cost of production, when determined by any method selected, this amount may be added to the cost of production.

INFLUENCE OF SEASONS ON COST FACTORS.

Since the winter and summer seasons have a marked influence on the principal factors entering into the cost of producing milk, the results have been computed separately for those periods. The months from November to April, inclusive, represent the winter season, and from May to October the summer season. This division

FIG. 1.—Better breeding saved labor. The owner of this herd of cows, averaging 9,200 pounds of milk annually, had to feed and milk only 9 cows to obtain as much milk as 12 average association cows produced.

of time was based directly on the change in methods of herd management made in November and May.

The various tables in this bulletin are based upon figures obtained during the 2 years of the study, and all results are expressed in weighted averages in which the weights represent the relative importance of the separate items averaged.

DESCRIPTION OF HERDS.

During the first year the 16 herds on which records were tabulated contained 334 grade and purebred cows, mostly of the Holstein breed, which produced on the average 6,877 pounds of milk testing 3.8 per cent butterfat. In the 21 herds included in the study the second year there were 404 cows of approximately the same breeding

which averaged 6,987 pounds of milk testing 3.6 per cent butterfat. Grade cows made up 78 per cent of those included in the 2-year study and the rest were purebred. Complete records for 2 consecutive years were obtained on 12 of the herds whose owners cooperated throughout both years. The number of cows in the herds is obtained by adding the cows in each herd each month and dividing the total by 12.

TABLE 1.—*Number of cows in herds, average yearly production of milk, and calves produced each year.*

Herd No.	1915–16.			1916–17.		
	Cows in herd.	Calves produced per year.	Production per cow per year.	Cows in herd.	Calves produced per year.	Production per cow per year.
	Number.	*Number.*	*Pounds.*	*Number.*	*Number.*	*Pounds.*
102	13.6	13	6,139.9			
103	23.2	20	6,957.4	20.5	20	6,237.0
104	27.5	20	6,562.6			
106	25.8	17	7,091.0	28.0	26	6,890.8
107	16.1	13	6,331.4	18.7	21	6,162.3
108	28.4	23	6,309.8	29.8	30	5,660.6
109	18.9	14	7,622.5	19.4	17	7,866.2
110	11.5	13	6,710.0	11.2	9	5,778.1
111	18.4	17	9,063.0	13.7	13	9,083.4
112	28.9	25	4,915.0			
113	16.5	12	6,296.9	15.0	13	5,566.7
114	9.8	8	6,710.8	9.8	10	7,007.6
115	14.4	15	9,127.0	15.2	11	7,538.3
116	7.8	6	9,452.6	9.4	8	9,127.5
117				18.2	13	6,454.6
118	37.5	32	6,455.2			
119	35.2	18	7,306.6	31.8	33	7,750.8
121				17.8	13	7,166.3
122				13.8	16	6,682.8
123				17.3	17	7,933.8
124				24.8	22	8,156.2
125				22.5	19	9,106.0
126				27.6	27	6,947.0
127				15.6	17	4,779.4
128				23.9	24	5,465.4
Total	333.5	266		404.0	379	
Average	20.8	16.6	6,877.0	19.2	18.0	6,987.0

According to these figures 87 per cent of the cows produced a living calf each year.

TABLE 2.—*Per cent of cows dry during the winter, summer, and year.*

Period.	Winter.	Summer.	Year.
	Per cent.	*Per cent.*	*Per cent.*
First year	12.6	12.1	12.4
Second year	13.2	12.7	13.0

There was only a slight variation in the percentage of dry cows in the two seasons. This accounts for the uniformity of production of milk for the seasons. The calf crop was divided equally between seasons.

REQUIREMENTS FOR PRODUCING 100 POUNDS OF MILK.

It will be noted in Table 3 that with few exceptions the dollars and cents values have not been reported. Since prices of feed and labor change, results are more valuable when reported in a convertible form, such as pounds of feed and hours of labor. The average cost of hauling purchased concentrates to the dairies was $1 a ton and the average cost of grinding was 7 cents a bushel for ear corn and 4 cents for shelled corn and other grains.

TABLE 3.—*Unit requirements by seasons for producing 100 pounds of milk during the two years.*

Item.	Winter.		Two winters.	Summer.[1]		Two summers.
	1915–16	1916–17		1915–16	1916–17	
Feed:						
Purchased concentrates.....pounds..	24.5	16.5	20.0	15.9	13.2	14.5
Home-grown grains.....do....	17.7	19.3	18.6	4.3	6.5	5.5
Total concentrates.....do....	42.2	35.8	38.6	20.2	19.7	20.0
Noncommercial roughage.....do....	23.2	13.0	17.4	.9	5.6	3.4
Commercial:						
Carbohydrate hay.....do....	17.4	29.7	24.3	2.4	13.2	8.2
Legume hay.....do....	23.8	26.0	25.1	14.9	16.5	15.8
Total dry roughage.....do....	64.4	68.7	66.8	18.2	35.3	27.4
Silage and other succulent roughage.....do....	153.2	143.2	147.6	56.4	63.2	60.1
Hauling and grinding concentrates.....dollars..	0.03	0.03	0.03	0.014	0.014	0.014
Pasture.....acres..	.....	.....	.....	.041	.039	.040
Bedding.....pounds..	20.3	20.4	20.3	.....	.....	.....
Labor:						
Human labor.....hours..	2.6	2.5	2.5	2.2	2.2	2.2
Horse labor.....do....	.3	.2	.3	.2	.2	.2
Overhead and other costs:						
Building charges.....dollars..	0.132	0.104	0.116	0.131	0.114	0.122
Equipment charges and dairy supplies.....do....	.081	.065	.072	.079	.071	.075
Herd charges:						
Taxes, insurance, veterinary, medicines, disinfectants, and cow-testing association.....dollars..	.044	.043	.043	.044	.047	.045
Interest on cow investment.....do....	.079	.066	.072	.078	.073	.075
Cost of keeping bull.....do....	.077	.056	.065	.066	.051	.058
Total.....do....	.413	.334	.368	.398	.356	.375
Depreciation on cows.....do....	.109	.....	.017	.108	.....	.018
Appreciation on cows.....do....	.....	.054	.....	.....	.060	.....
Total overhead and other costs.....do....	.522	.280	.385	.506	.296	.393

[1] As the study was begun in August, 1915, the summer designated as 1915–16 includes September and October of 1915 and May, June, July, and August of 1916. The summer of 1916–17 includes the corresponding months of those years.

Because the inventories showed a depreciation on cows the first year and an increase the second, these items were not added to the sum of the overhead and other costs in order that they might be more easily considered separately. The fact that there was a depreciation shown on the herd for the first year and an increase the second is due to a combination of factors. When the last inventory was taken, the influence of the increase in market price of cattle during the second year was apparent. Especially was this true in the case of cows in their first and second lactation periods, on which there

seemed to be a greater increase in value than was warranted by production due to increased age.

On the other hand, due to the fact that most of the dairymen were replacing their poorer cows with more promising younger ones, the herds the second year contained a rather large proportion of heifers which had freshened for the first time, which accounts for the increase in value between the time they freshened and the time the second inventory was taken.

The difference between the overhead requirements per 100 pounds of milk for the two years, aside from the depreciation and appreciation on the cows, is due mostly to a greater average production the second year, which lowered the cost for each 100 pounds of milk produced.

The item of bull charges includes feed, labor, and overhead costs of keeping the bull. On account of the feed and labor being expressed in dollars and cents, a table showing in detail the unit requirements for keeping a bull in the winter and summer and for a year is presented on page 10. If desired, current rates and prices may be applied to these records.

CREDITS FOR EACH 100 POUNDS OF MILK PRODUCED.

CALVES.

The credits for calves amounted during the winter periods to 0.012 of one calf for each 100 pounds of milk produced and during the summer periods to 0.013 of one calf. In this case the credit amounted to $0.12 for each 100 pounds of milk produced in winter, and $0.13 per 100 pounds of summer milk. This was based on the price for which they sold for veal or at the prevailing local price for heifer calves at birth.

MANURE.

For each 100 pounds of milk produced in the two winter periods, there was a credit of 332 pounds of manure, including bedding which contained 1.62 pounds nitrogen, 0.53 pound commercial phosphoric acid, and 1.66 pounds potash. This was computed from the manurial constituents in the feed and the methods of handling the manure.

For each 100 pounds of milk produced in the summer there was a credit of 54 pounds of manure, which was assumed to be of the same quality as that produced in the winter and contained 0.26 pound nitrogen, 0.08 pound commercial phosphoric acid, and 0.24 pound potash. The methods used in determining the credit for manure in the winter and summer periods are treated in detail, beginning on page 23 of this bulletin.

REQUIREMENTS FOR KEEPING A COW ONE YEAR.

Since a large part of the feed required in the summer was supplied in the form of pasture grass, much less feed was consumed in the barn than during the winter. Attention is directed to the fact that the rations fed in the barn by these dairymen contained a relatively larger proportion of high-protein concentrates and legumes in the summer than in the winter. When the pastures became short, those dairymen who had alfalfa and clover fed them, while those who did not have legumes purchased concentrates in order to maintain the production of their cows.

TABLE 4.—*Quantities of various classes of feeds required and expenses incurred for keeping a cow during each season and for the entire year.*

Item.	Winter.	Summer.	Entire year.
Number of cows	740.0	734.8	737.5
Average production.....pounds..	3,540	3,397	6,937
Feed:			
Purchased concentrates.....do....	707	491	1,198
Home-grown grains.....do....	659	187	848
Total concentrates.....do....	1,366	678	2,046
Noncommercial roughage.....do....	616	116	734
Commercial carbohydrate hay.....do....	862	278	1,143
Legume hay.....do....	887	536	1,424
Total dry roughage.....do....	2,365	930	3,301
Silage and other succulent roughage.....do....	5,224	2,042	7,276
Hauling and grinding concentrates.....dollars..	1.06	.45	1.53
Pasture.....acres..	.....	1.36	1.36
Bedding.....pounds..	720	.....	720
Labor:			
Human labor.....hours..	90.1	74.4	164.5
Horse labor.....do....	8.9	7.4	16.2
Overhead and other costs:			
Building charges.....dollars..	4.12	4.14	8.27
Equipment charges and dairy supplies.....do....	2.53	2.55	5.09
Herd charges:			
Taxes, insurance, veterinary, medicine, disinfectants, and cow-testing association.....dollars..	1.55	1.56	3.12
Interest on cow investment.....do....	2.55	2.57	5.14
Cost of keeping bull.....do....	2.32	1.97	4.29
Total.....do....	13.07	12.79	25.91
Depreciation on cows.....do....	.60	.60	1.20
Appreciation on cows.....do....	.....	.....	.....
Total overhead and other costs.....do....	13.67	13.39	27.11

Approximately 16 hours less human labor was performed per cow in the summer period than in the winter. It may be seen in Table 17, which shows the labor used in producing, handling, and hauling the milk, that this difference is due to more work being done in the winter when the cows were in the barn than in the summer when on pasture. The labor required for handling and hauling the milk was practically the same for both seasons.

A more detailed account of the units of cost will be found in the back part of this bulletin where the feed, labor, overhead, and other costs required for all the milk produced by the herds during the two years' study are reported in detail.

CREDITS PER COW FOR THE WINTER, SUMMER, AND ENTIRE YEAR.

During the first year of this study living calves were produced by 80 per cent of the cows, while 94 per cent produced live calves the second year. The average value of these calves was $10.08. Most of the heifer calves were raised by the dairymen who produced them, but some were sold to neighbors to be raised. The grade bull calves were vealed and usually sold for about $10 each, which was also about the average price of heifer calves which were sold to be raised. Since the purebred cows were given the same values as grade cows of like producing ability, the purebred bull calves were credited to the herds at what they would have been worth when 4 days old to fatten for veal, and, similarly, the purebred heifer calves were given the same value as grade heifer calves. The value of milk consumed by veal calves was covered in the selling price of the calves.

CREDIT FOR MANURE.

The average credit allowed per cow per year for manure and bedding included the manure from the bulls, and represents what was or could have been saved by practicable methods of handling. Since the total cost of keeping bulls is charged against the cows under overhead and other costs, the manure from the bulls is included as a direct credit to the herd. Of this total credit per cow 5.6 tons of manure and bedding were produced by the cows alone in the winter, and 0.7 of a ton of manure in the summer, amounting to 6.3 tons of manure and bedding per cow per year. (See page 23.)

TABLE 5.—*Credits for calves and manure per cow (bull manure included), and fertilizing constituents contained in the manure and bedding.*

Item.	Winter.	Summer.	Year.
Calves per cow	0.44	0.43	0.87
Manure per cow.....tons..	5.9	0.9	6.8
Constituents of manure:			
Nitrogen.....pounds..	57.4	8.9	66.3
Phosphoric acid.....do....	18.6	2.8	21.4
Potash.....do....	58.8	8.2	67.0

REQUIREMENTS FOR KEEPING A BULL.

The record on one bull for one month, called a bull-month, was taken as a working unit. The number of bull-months for the winter and summer periods was the same.

On 10 of the farms the bulls were allowed to run with the cows, and on some of the others were either put on cables or tethered out in the summer and so required little attention, which accounts for the smaller amount of labor per bull in the summer period. In some cases the bulls which ran with the cows were not put into the barns at all while the pasture was plentiful, and received no attention other than being driven from the pasture with the herd.

TABLE 6.—*Requirements for keeping a bull by seasons based on averages obtained from the equivalent of 33 bulls varying from 1 year old to maturity and kept for fractional parts of a year.*

Item.	Average of two winters.	Average of two summers.	Average of two years.
Feed:			
Concentrates—			
Purchased.....pounds..	335.0	307.7	642.7
Home grown.....do....	518.7	238.3	757.0
Total concentrates.....	853.7	546.0	1,399.7
Dry roughage—			
Noncommercial.....do....	528.7	37.2	565.9
Commercial carbohydrate.....do....	853.4	733.3	1,586.7
Legume.....do....	934.7	938.1	1,872.8
Total dry roughage.....	2,316.8	1,708.6	4,025.4
Succulent roughage.....do....	4,331.2	1,671.6	6,002.8
Bedding.....do....	645.4	.....	645.4
Pasture.....	.....	$4.56	$4.56
Human labor.....hours..	23.8	11.9	35.7
Overhead costs:			
Interest on bull investment.....	$7.83	$7.83	$15.66
Depreciation on bull.....	2.89	2.89	5.79
Bull's share of buildings.....	4.12	4.14	8.26
Total overhead costs.....	14.84	14.86	29.71

The reason why the yearly average depreciation per bull amounted to only $5.79 was that many of the bulls increased in size after being taken into the herds, and when sold for beef brought as much as or more than the initial cost.

SUMMARY STATEMENT OF COSTS FOR THE TWO YEARS, BY SEASONS.

The cost of the various requirements for keeping a cow and for producing 100 pounds of milk during the 2 years is presented by seasons in Tables 7 and 8. During the second winter and summer the total cost, except the herd inventory variation, was $7.32 and $3.25 more per cow and 6 cents and 16 cents more per 100 pounds of milk, respectively, than during the corresponding seasons of the first year. The cost per cow and per 100 pounds of milk did not increase in the same proportion the second year because of the variation in seasonal production of the herds. That there was an increase of only 6 cents in the cost of 100 pounds of milk during the second winter over that of the first, as compared with $7.32 increase in the cost of keeping a cow during the same period, is the direct result of the higher production per cow during the second winter.

The high increase in the cost of producing 100 pounds of milk during the summer of the second year and the comparatively small increase in the cost per cow, is due to a lower average production during this period than during the summer of the first year. Higher feed prices the second year account in most part for the higher cost per cow during that period.

TABLE 7.—*Cost of producing 100 pounds of milk during four seasons, charge for management not included.*

Item.	1915–16		1916–17	
	Winter.	Summer.	Winter.	Summer.
Feed cost	$1.149	$0.466	$1.28	$0.702
Pasture cost	.....	.340	.....	.275
Bedding cost	.031	.....	.013	.....
Labor cost	.391	.309	.391	.342
Overhead and other costs, except herd inventory variation	.414	.399	.334	.357
Total cost except herd inventory variation	1.985	1.514	2.048	1.676
Appreciation on cows	.....	.....	.054	.059
Depreciation on cows	.109	.108	.....	.....
Total cost	2.094	1.622	1.994	1.617
Credit for calves	.111	.109	.134	.148
Credit for cow manure and used bedding	.397	.052	.520	.075
Credit for bull manure	.021	.012	.026	.016
Total credit	.529	.173	.680	.239
Net cost	1.565	1.449	1.314	1.378

Higher feed prices during the second year were almost offset by the herd appreciation, together with the increased production of

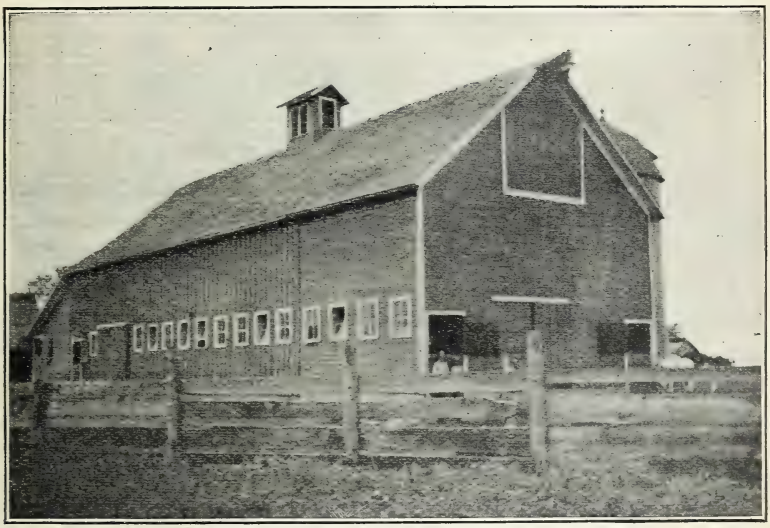

FIG. 2.—Well-lighted stables kept the hired men contented and promoted health in the cows.

milk. The total cost was 10 cents less per 100 pounds of milk the second winter than it was the first, and was approximately the same for the two summers.

Calves sold for a higher price the second year and the fertilizing constituents in the manure and bedding also had a higher value on account of the higher price of commercial fertilizers.

The higher credit allowed for manure in the winter tended to equalize the net cost for the winter and summer periods. The values per pound at which the fertilizing constituents in the manure and used bedding were credited to the cows the first year were 18 cents for nitrogen, 4½ cents for phosphoric acid, and 5 cents for potash, as compared with 25 cents, 6 cents, and 6⅘ cents a pound for the same constituents during the second year. The value of a ton of manure the first year was found to be $2.38 as compared with $3.29 for the second year.

TABLE 8.—*Cost of keeping a cow during four seasons, charge for management not included.*

Item.	1915–16.		1916–17.	
	Winter.	Summer.	Winter.	Summer.
Feed cost	$39.10	$16.21	$46.78	$23.41
Pasture cost	.....	11.82	.....	9.16
Bedding cost	1.05	.....	1.56	.....
Labor cost	13.29	10.73	14.30	11.40
Overhead and other costs, except herd inventory variation	14.11	13.88	12.23	11.92
Total cost except herd inventory variation	67.55	52.64	74.87	55.89
Appreciation on cows	.....	.....	1.98	1.99
Depreciation on cows	3.71	3.75	.....	.....
Total cost	71.26	56.39	72.89	53.90
Credit for calves	3.77	3.81	4.90	4.93
Credit for cow manure and used bedding	13.52	1.75	19.02	2.50
Credit for bull manure	.70	.45	.96	.54
Total credit	17.99	6.01	24.88	7.97
Net cost	53.27	50.38	48.01	45.93

COST OF PRODUCTION BY HERDS AND BY SEASONS.

The varying net costs of producing 100 pounds of milk, the average number of cows and the average production of milk per cow are shown for each herd during the two seasons of each year in figures 1 and 2. It will be noted that although there is a tendency toward lower cost of production for the higher-producing herds this rule does not always apply. In some cases the other factors of cost outweigh the influence of high production, or, again, the high production may have been obtained at too great an expense.

This may have been caused by feeding the cows beyond their ability to produce economically. For example, in the winter of 1916–17 Herd 127 with a 6-months' production of only 2,506 pounds per cow, produced milk at $1.04 per 100 pounds while it cost $1.50 to produce 100 pounds from Herd 125, in which the cows made an average winter production of 5,062 pounds of milk. The low cost in Herd 127 was made possible by a low overhead due to small investment in buildings and cows and a low feed cost, while Herd 125 showed high overhead costs, due to expensive buildings and cattle and a high feed cost, due to exceptionally heavy feeding. But to obtain the income on an equal volume of milk it would have been necessary for the owner of Herd 127 to keep two cows for every cow kept in Herd 125.

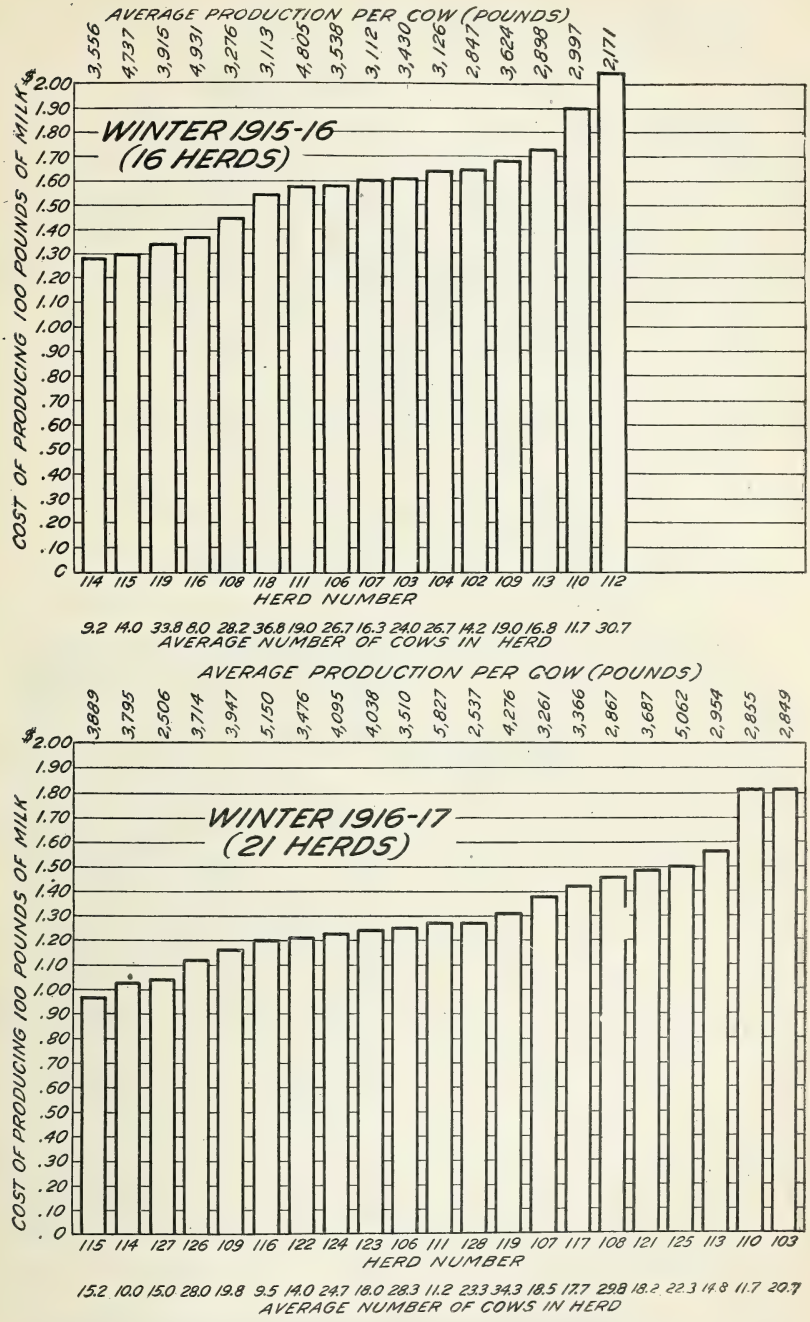

FIG. 3.—Average production per cow and cost of producing 100 pounds of milk in winter.

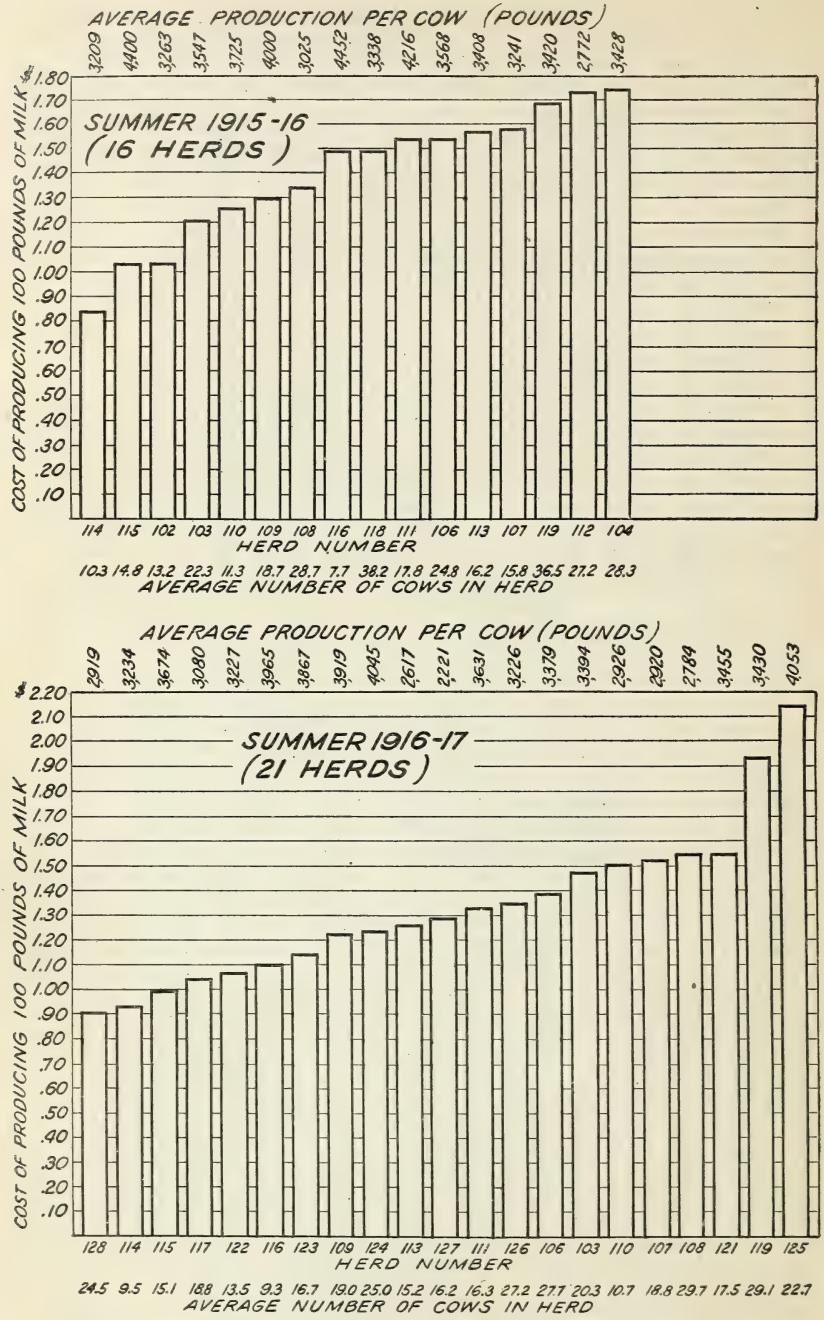

FIG. 4.—Average production per cow and cost of producing 100 pounds of milk in summer.

The average cost of producing 100 pounds of milk from all the cows on which records were obtained in each of the winter and summer seasons can be found in the financial statement in Table 7.

DETERMINATION OF BULK LINE COST.

During the last 2 or 3 years a number of methods have been developed for determining the price of milk on a cost of production basis, and these plans are being used by a number of communities as a basis for milk prices. If in these plans the figures that are used merely represent the average cost of production, it is evident that practically one-half of the producers whose costs are above the average will not be sufficiently well compensated for their efforts. This will have a tendency to discourage production and decrease the available supply. On the other hand, it would not be advisable to pay a price based on the least economical producer since this would encourage his poor methods and stimulate an overproduction by the more economical producers.

Between these two extremes there is a point under which the greatest volume of milk is produced. Such a point or line of demarcation has been designated as the bulk line. This bulk line, shown in figures 5 and 6, is arbitrarily placed to eliminate that milk which is produced at a relatively higher cost as compared with the bulk of the milk produced, and yet is high enough to stimulate a corresponding increase in the low-cost herds.

If these figures are used in determining a price for milk it is questionable whether the credit for appreciation on cows should be allowed, since it is doubtful whether normal market conditions would ever produce an appreciation on cows. Furthermore the appreciation in the value of cows due to market conditions gives a "paper credit" rather than real credit since the cows were not actually sold.

PERCENTAGE COMPARISON OF FACTORS IN MILK PRODUCTION.

With the exception of November, the gross feed and bedding cost in Table 9 ran higher during the winter months than during the summer months. With this one exception there was apparently no large variation in the feed cost from month to month within any season during the two years.

Since the manure and soiled bedding resulted from the feed and bedding used by the cows, the credit for these latter items was subtracted from the cost of feed and bedding when making a comparison of the net feed and bedding cost by months. The cost of feed and bedding minus the credit for manure and bedding gave the net feed and bedding cost. When the credit for manure and bedding was subtracted, there was no large variation in the cost of feed from month to month throughout the two years with the exception of

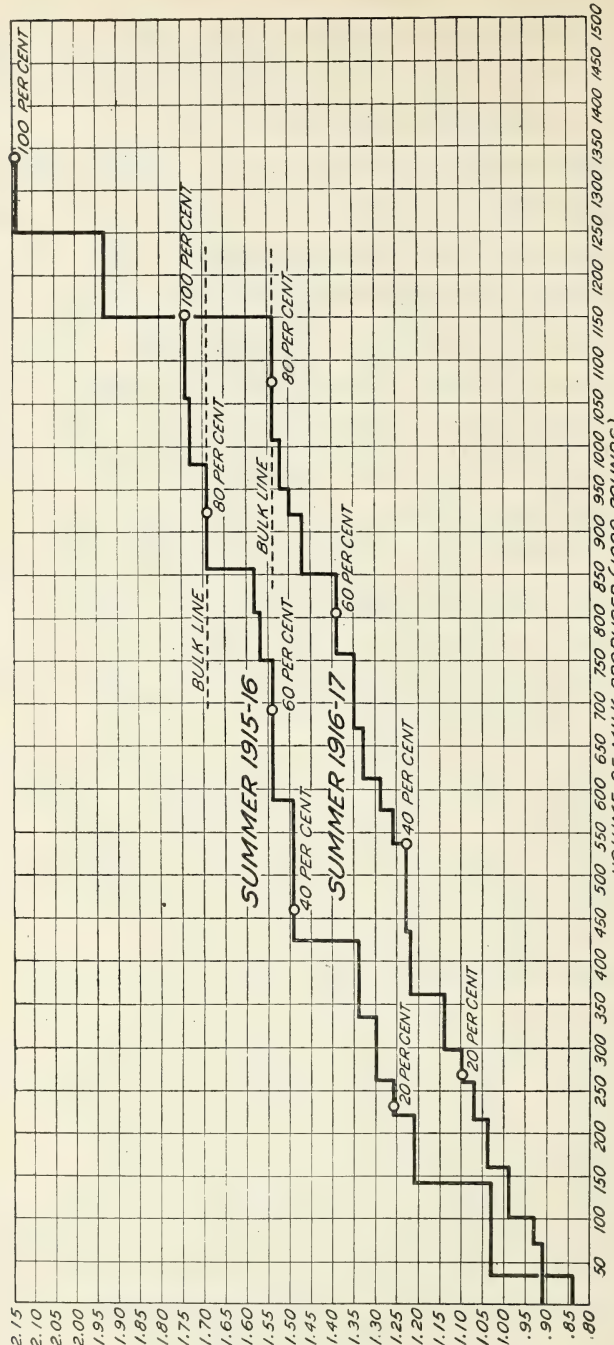

FIG. 5.—Volume of milk produced and the net cost per 100 pounds in summer.

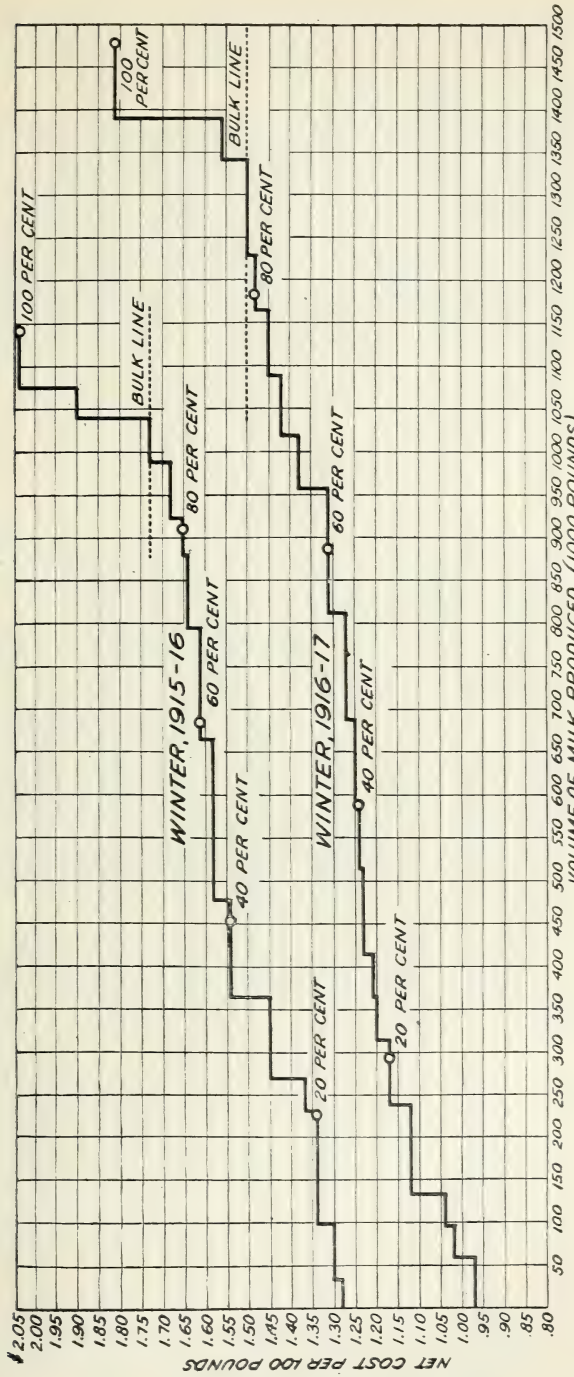

FIG. 6.—Volume of milk produced and the net cost per 100 pounds in winter.

November. The lower feed cost for November was accentuated because the credit for manure and bedding was divided evenly among the 6 winter months regardless of the amount of feed consumed in the different months.

The human labor performed each month, especially when expressed on the "per cow" basis, was fairly constant within each seasonal period. The labor required to produce 100 pounds of milk fluctuated a little more, due to the variation in the amount of milk produced. It required 0.4 of an hour more human labor to produce 100 pounds of milk in the winter of the first year than in the summer, as compared with a difference of 0.3 of an hour for the second year. Attention is directed to the fact that there was little variation in the average monthly labor required to produce 100 pounds of milk or to keep a cow in corresponding seasons of both years.

TABLE 9.—*Monthly and seasonal distribution of milk prices, milk produced, feed cost and labor required.*

YEAR 1915–16.

Month, season, and year.	Income per 100 pounds milk less freight.	Per cent of year's income from milk sold and used.	Per cent of year's milk sold and used.	Per cent of year's feed and bedding cost.	Feed and bedding cost less manure and bedding credit.	Human labor.		Horse labor.	
						Per 100 pounds milk.	Per cow.	Per 100 pounds milk.	Per cow.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Hours.*	*Hours.*	*Hours.*	*Hours.*
May	$1.57	7.9	8.8	6.4	9.7	2.0	12.7	0.3	1.6
June	1.41	6.9	8.6	7.3	7.3	2.1	12.3	.3	1.6
July	1.72	7.8	8.0	6.4	7.9	2.4	13.2	.3	1.8
August	1.81	8.0	7.7	7.1	7.5	2.4	12.7	.2	1.3
September	1.76	8.3	8.4	6.7	8.4	2.1	12.0	.2	1.2
October	1.72	8.7	8.8	6.9	10.1	2.2	13.0	.2	1.2
Summer	1.66	47.8	50.3	40.8	50.9	2.2	12.6	.2	1.5
November	1.91	8.9	8.2	7.2	5.9	2.6	13.6	.3	1.3
December	1.92	9.1	8.3	10.2	8.1	2.7	14.9	.3	1.4
January	1.86	8.8	8.2	10.9	8.7	2.9	16.2	.3	1.4
February	1.79	8.3	8.1	9.7	7.7	2.6	14.6	.3	1.5
March	1.76	8.7	8.6	10.8	9.4	2.6	16.1	.3	1.6
April	1.77	8.4	8.3	10.4	9.3	2.5	14.5	.3	1.8
Winter	1.84	52.2	49.7	59.2	49.1	2.6	15.0	.3	1.5
Year	1.75	100.0	100.0	100.0	100.0	2.4	13.8	.3	1.5

YEAR 1916–17.

May	$2.08	8.8	9.2	7.5	7.8	2.0	13.0	.2	1.0
June	1.77	7.1	8.7	5.8	9.0	1.8	11.3	.2	.9
July	2.28	8.6	8.2	6.3	7.7	2.0	11.6	.2	1.0
August	2.45	7.7	6.9	6.0	8.6	2.4	11.5	.2	1.0
September	1.85	6.1	7.2	6.7	8.1	2.5	12.3	.2	1.0
October	2.15	7.4	7.5	7.8	8.5	2.6	13.3	.2	1.1
Summer	2.09	45.7	47.7	40.1	49.7	2.2	12.2	.2	1.0
November	2.30	8.1	7.6	8.4	4.9	2.7	14.0	.2	1.2
December	2.49	9.7	8.5	9.9	8.8	2.7	15.8	.3	1.6
January	2.16	9.1	9.1	10.3	9.8	2.6	16.0	.3	1.6
February	2.07	8.4	8.8	9.7	8.1	2.4	15.0	.2	1.4
March	1.97	8.5	9.4	10.8	9.6	2.4	15.9	.2	1.5
April	2.54	10.5	8.9	10.8	9.1	2.1	13.6	.2	1.4
Winter	2.25	54.3	52.3	59.9	50.3	2.5	15.1	.2	1.4
Year	2.17	100.0	100.0	100.0	100.0	2.3	13.6	.2	1.2

The figures in Table 9 indicate that there is no close relation between the monthly cost of milk and the monthly price received for it during the 2 years. There was no regular variation in the monthly cost within any of the seasons except a little lower cost in November, indicating that the cost in the section in which these records were obtained was about the same from month to month during the summer or during the winter season. The price received for the milk, however fluctuated sharply from month to month.

The methods by which the amounts and values of the various items considered in these studies were determined will be discussed briefly here under the several heads of feed, labor, and overhead and other costs.

FACTORS INVOLVED IN THE COST OF PRODUCING MILK.

FEED.

EXPLANATION OF TERMS.

Concentrates is a term applied to grains and by-products from the milling of grains or seeds, comprising those feeds containing a large amount of nutritive material in a relatively small bulk.

Dry roughage includes various hays and other coarse feeding stuffs.

Noncommercial dry roughage is applied to corn stover and corn fodder and any other dry roughage for which price quotations are not given in the trade papers.

Leguminous roughage includes alfalfa, cowpea, clover, and other legume hays having such a small percentage of other grasses as not materially to affect the protein content.

Commercial carbohydrate hay includes all commercial hays except those classified as leguminous roughage.

QUANTITY OF FEED USED.

The amounts of the different kinds of feed were based on the weights obtained for the total amount which each herd received in one full day. The feed was weighed for each herd on one day of every month, while this study was being made. The weighing of the feed, with the exception of that which three herds received the first year, was done by the cow tester of the Porter County Cow-Testing Association. The field agent who also made the visits to each herd every month, weighed the feed for Herds 114, 115, and 116 during the first year and checked up closely on the tester's weights for all herds each month for both years.

FEED PRICES.

The home-grown feeds were figured at market prices on the farm plus any expense connected with them, such as grinding, hauling, and baling. Oats and ear corn were hauled to the mill to be ground. Limited barn space made it necessary for some of the dairymen to

bale their straw and hay. The purchased feeds were figured at their actual cost at the feed store or on the track, plus the cost of hauling them home. The same methods were used in figuring the value of bedding. However, some of the bedding consisted of refuse hay and shredded corn stover left in the mangers, for which no charge was made.

TABLE 10.—*Average cost of feed per ton on the farm, including cost of grinding home-grown grains and hauling purchased concentrates.*

Feed.	1915–16.		1916–17.	
	Winter.	Summer.	Winter.	Summer.
Purchased concentrates	$28.51	$27.27	$35.89	$36.58
Home-grown grain	21.44	23.66	33.95	40.23
Commercial carbohydrate hay	10.20	7.59	10.90	11.41
Noncommercial roughage	5.13	7.35	5.95	5.28
Legume hay	12.83	9.57	12.89	13.34
Succulent roughage	4.03	4.08	4.03	4.08

PASTURE.

The cost of pasture was determined by adding to the interest on the investment in land the cost of maintaining fences, and incidentals, such as seeding, cutting weeds, etc. The investment in land was obtained by subtracting the value per acre of the improvements on the farm, as determined by prorating their value in accordance with the quality of the different classes of land on a farm, from the improved value per acre. In one or two instances where land was rented at so much an acre for pasturage purposes, this value was taken. The cost of pasture was distributed over the 6 summer months as nearly as possible in proportion to the quantity of feed the herd received from the grass each month.

LABOR.

The amount of different kinds of labor was obtained by timing the work performed during one entire day every month in each dairy. The rate per hour was computed each month for every farm on a basis of the number of hours available for work each month and the wages paid by that farmer, and any other expenses connected with the hired help, such as board and room or having a horse kept. The number of hours was found by using the average length of the working day, with time out for meals, and hours of work performed on Sunday. Board for hired help was computed on the basis of local rates.

When these costs were tabulated, no charge for management was included. The labor performed by the managers was charged to the herds at hired men's rates. Although a charge for management should be included in the requirements for milk production, no satisfactory method was found for determining what this should be for all the dairies.

TABLE 11.—*Average labor rates per hour.*

Class of labor.	1915–16.		1916–17.	
	Winter.	Summer.	Winter.	Summer.
Manager [1]	$0.153	$0.149	$0.160	$0.164
Hired man	.129	.118	.137	.140
Woman	.128	.122	.157	.152
Boy and girl	.088	.081	.100	.090
Horse	.100	.100	.100	.100

[1] The rate per hour for the labor performed by the managers is a little higher than that for hired men because as a rule the managers would have commanded a considerably higher monthly wage as hired men than the men they hired. No charge for management, however, is included in this rate.

DISTRIBUTION OF LABOR.

The summaries in Table 12 show that 80 and 76 per cent of the total labor for the winter and summer, respectively, was required to

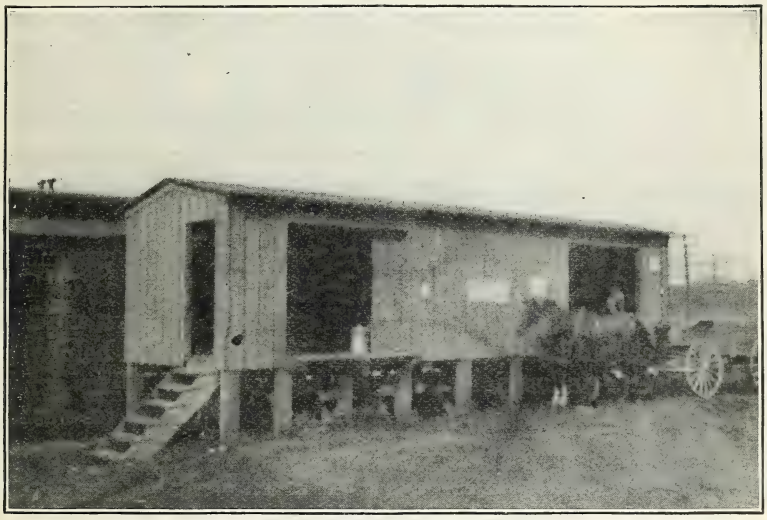

FIG. 7.—Meeting an early train 365 mornings in the year was an important item of labor.

do work in the barn, such as feeding, cleaning, and milking; also, that the main difference in the amount of labor performed for 100 pounds of milk in the summer and winter was due to a difference in the production labor for the two seasons.

TABLE 12.—*Human labor used in producing, handling, and hauling 100 pounds of milk to the shipping platform.*

Kind of work	Winter.				Two winters.		Summer.				Two summers.	
	1915–16.		1916–17.				1915–16.		1916–17.			
	Hours.	*Per cent.*	*Hours.*	*Per cent.*	*Hours.*	*Per cent.*	*Hours.*	*Per cent.*	*Hours.*	*Per cent.*	*Hours.*	*Per cent.*
Production	2.12	80.2	1.98	79.9	2.04	80.0	1.65	75.8	1.69	77.1	1.67	76.5
Handling	.31	11.8	.30	12.3	.31	12.1	.33	15.2	.32	14.6	.33	14.9
Hauling	.21	8.0	.19	7.8	.20	7.9	.20	9.0	.18	8.3	.19	8.6
Total	2.64	100.0	2.47	100.0	2.55	100.0	2.18	100.0	2.19	100.0	2.19	100.0

TABLE 13.—*Per cent and hours of labor performed by each class of help in the production of 100 pounds of milk.*

WINTER.

Class of labor.	Distribution of work performed.			Labor per 100 pounds milk.		
	1915–16.	1916–17.	Average.	1915–16.	1916–17.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Hours.*	*Hours.*	*Hours.*
Managers	39.9	47.2	43.5	1.05	1.17	1.12
Hired men	49.4	33.0	41.2	1.30	.81	1.03
Total man labor	89.3	80.2	84.7	2.35	1.97	2.15
Women	8.2	14.2	11.2	.22	.35	.29
Boys and girls	2.5	5.6	4.1	.07	.14	.11
Total	100.0	100.0	100.0	2.64	2.47	2.55

SUMMER.

Managers	40.2	42.6	41.4	0.88	0.93	0.91
Hired men	43.6	35.0	39.3	.95	.77	.85
Total man labor	83.8	77.6	80.7	1.83	1.70	1.76
Women	13.0	13.4	13.2	.28	.29	.29
Boys and girls	3.2	9.0	6.1	.07	.20	.14
Total	100.0	100.0	100.0	2.18	2.19	2.19

During the first winter studied, as shown in Table 13, the managers did 39.9 per cent of the dairy work, and the hired men performed 49.4 per cent of it. The remaining 10.7 per cent was done mostly by the women. A comparative study of the percentage of labor performed by each class of help for each season shows how the labor of the manager and his family replaced that of the hired help which was attracted to industrial plants by higher wages. The women limited their efforts for the most part to milking and to washing utensils, and actual observation showed that in these operations they were just as efficient as the men or even more so.

OVERHEAD AND OTHER COSTS.

HERD.

A pound of milk from a purebred cow was worth no more than from a grade cow. Purebred cows were inventoried at fair prices for grade animals of similar producing ability, and the purebred calves were given corresponding grade values. This method eliminated both the higher overhead charge on cattle and the larger credit for the purebred value of calves.

Each herd was inventoried the first month, and interest at the rate of 6 per cent was computed on the value of the cows and bulls at that time. An account was kept of all animals coming in or going out of the herd and what they were worth at that time. Losses due to death in the herd were accounted for in the difference between the inventories. At the end of the year another inventory was taken

and the difference between this, plus the receipts for the outgoing animals and hides sold, and the first inventory, plus the value of incoming animals at the time they entered the herd during the year, constituted the depreciation or appreciation on the herd for the year. As in the case of feed and labor the records on the cows and bulls were kept separate for each herd in order that the requirements for producing a certain quantity of milk, aside from the cost of keeping bulls, would be available for study. Records were obtained of the actual costs of taxes, insurance, veterinary services, medicine, disinfectants, and cow-testing dues.

BUILDINGS.

The buildings, including silos, were inventoried at the beginning and the end of the year and interest at 5 per cent was figured on the value of those used for the cows, as shown by the first inventory. The first inventory value, divided by the years it was estimated the buildings would remain in a usable condition, constituted the depreciation charge. The cost of painting, shingling, and repairs was computed, and wherever possible the exact cost was obtained and recorded under "Upkeep and repairs." The dairies were charged with their share of the actual taxes and insurance paid, as shown by county records and insurance policies.

EQUIPMENT.

The dairy equipment was inventoried at the beginning and the end of the year. Interest at 6 per cent was charged on the first inventory value. The difference between the first inventory, plus equipment purchased, and the one taken at the end of the year, plus equipment sold, was recorded as depreciation. A list of all repairs on equipment and dairy supplies purchased was kept by the dairymen and recorded each month. The taxes on equipment, as for cattle and buildings, were taken from the county records.

CREDIT FOR MANURE.

In the computation of credit to be allowed for winter manure, six factors were considered, namely, the fertilizing constituents contained in the feed consumed; the proportion of nitrogen, phosphoric acid, and potash not utilized in the bodies of the cows but voided in the manure; the per cent of the total manure which was voided in the barn; the per cent saved in handling and storing; the nitrogen, phosphoric acid, and potash in the bedding; and the value of these constituents in the manure and bedding at wholesale prices for commercial fertilizers.

The small quantity of manure saved in the barn in the summer was presumed to be of the same quality as that produced in winter,

and was credited to the cows at the same price per ton as winter manure.

A method of crediting manure was sought which would give definite figures on its fertilizing value, taking into consideration the manure available for return to the land, the method by which it was handled, and its constituents. It is believed that the system used is just and applicable. If, however, on certain individual farms or in certain localities the needs of the soil would not warrant the payment of market prices for all or part of the fertilizing constituents in the manure, adjustments should be made accordingly.

DETERMINATION OF FERTILIZING CONSTITUENTS IN FEED AND MANURE.

The amounts of nitrogen, phosphoric acid, and potash in the feed consumed were determined by use of the average analyses[1] of the actual feeds consumed. As the descriptions and, wherever possible, the analyses, of the different feeds were recorded, it was possible to approximate quite closely the actual amount of fertility the manure contained. In this way all the nitrogen, phosphoric acid, and potash contained in all the feed consumed by each herd in the winter six months was computed. Of these fertilizing constituents 75 per cent of the nitrogen, 70 per cent of the phosphoric acid, and 85 per cent of the potash were taken as representing the amounts that would be voided in the manure. These proportions are based on the results of digestion trials conducted by the Illinois and Pennsylvania experiment stations.[2]

The amount of nitrogen which, it was calculated, was returned in the manure was about 5 per cent lower than the average of the results of the two experiments, because the cows on which records were kept were not, for the most part, fed so heavily as the experiment-station cows and would naturally retain more of the nitrogen in their bodies. The phosphoric acid allowed was practically an average of the experiments, and the potash was about 2 per cent more, as it was thought the Illinois cows, since the experiment was conducted in June, excreted considerable potash through their skins, which would not hold true to so great an extent for cows in the winter period.

When the total manurial constituents in the feed had been determined for each herd they were credited to the cows in accordance with the scores which had been given to the herds for the total manure saved. Each dairy was scored on its efficiency in saving manure, taking into account such factors as manure voided in the barn, quantity of liquid lost in the barn, and length of time and method of storing. The ingredients of the manure credited to each herd were

[1] Taken from "Feeds and Feeding," by Henry and Morrison.

[2] See Hopkins, Soil Fertility and Permanent Agriculture, pp. 201-202.

then added to the nitrogen, phosphoric acid, and potash contained in the bedding. The amounts of these constituents thus obtained constituted the entire fertilizer credit the cows received.

The composition of an average ton of manure produced by each herd in the winter period of each year was determined by dividing the fertilizing constituents it contained by the number of tons produced. It was possible to calculate the tons of manure produced for 100 pounds live weight of cows by using an average of the results of three experiments conducted by the New York station, and one by the Ohio station, on the amount of manure produced by dairy

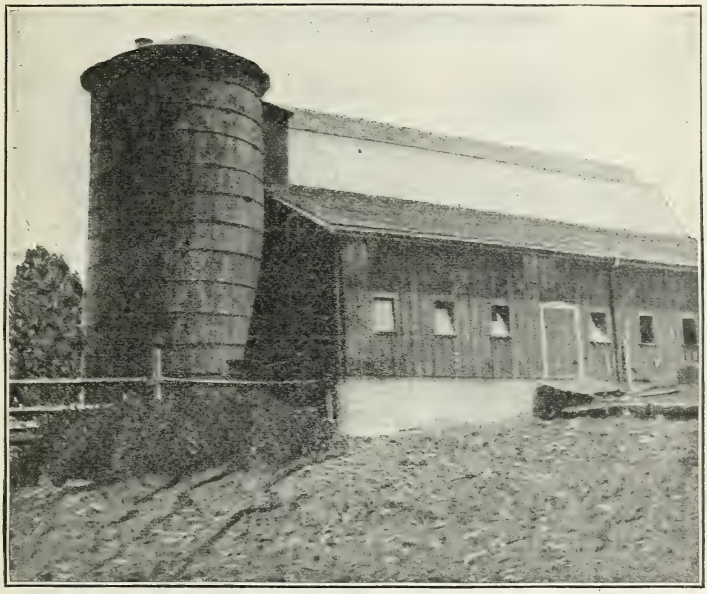

FIG. 8.—Brown streams which flowed from the exposed manure pile wasted dollars of fertility purchased in the feed.

cows.[4] It was found by averaging these experiments that approximately 13 tons of manure were produced annually for 1,000 pounds live weight of cows. Our computations on tons of manure produced are based on this figure together with the weights of the cows on which records were kept. The bedding used was largely straw.

The fertilizing constituents contained in one average ton of the manure and bedding from all the cows on which records were kept in the two winters were found to be as follows:

	Pounds.
Nitrogen	9.8
Commercial phosphoric acid	3.2
Potash	10.1

[4] Thorne, "Farm Manures," p. 97.

The average ton of manure, without bedding, produced by the cows in the winter months contained:

	Pounds.
Nitrogen	9.7
Commercial phosphoric acid	3.1
Potash	9.0

Since these amounts are based directly on the contents of the feed consumed and bedding used, they are fairly representative of the manure and bedding, and manure alone, from average dairy cows handled for market-milk production.

Table 14 summarizes the total costs represented by the feed, labor, and overhead and other charges, and the credits represented by the calves and manure:

TABLE 14.—*Proportion of total costs represented by feed, labor, and overhead and other costs.*

Cost factors.	Average of 2 winters.	Average of 2 summers.	Average of 2 years.
	Per cent.	*Per cent.*	*Per cent.*
Feed cost	59.6	36.0	49.4
Pasture cost		19.0	8.2
Feed and pasture cost	59.6	55.0	57.6
Labor cost	19.1	20.1	19.5
Overhead and other costs except depreciation on cows	20.1	23.4	21.6
Total cost except depreciation on cows	98.8	98.5	98.7
Depreciation on cows	1.2	1.5	1.3
Total cost including depreciation on cows	100.0	100.0	100.0
Credits allowed for calves and manure:			
Calves	6.0	8.0	6.8
Manure	23.7	4.8	15.5
Calves and manure	29.7	12.8	22.3

The depreciation on the cows is reported separately from the overhead and other costs because there was such a wide variation in the figures representing this item for the two years. There was a depreciation on cows during the first year, which increased the cost of production approximately 6 per cent, but during the second year the total cost was reduced by about 3 per cent on account of an appreciation in their value, due in part to an increase in market prices for cows. It will be noticed also that the labor cost amounted to 19.1 and 20.1 per cent, respectively, for the winter and summer periods, while the overhead and other costs, including depreciation on cows, increased from 21.3 per cent in the winters to 24.9 per cent in the summers. This difference, however, was not caused by a variation in the overhead and other costs, but was a result of a lower charge in the summer periods than in the winters for labor and feed, including pasture, which were required to produce a certain amount of milk. These percentages are necessarily changeable, since

they depend directly on the relative cost of the various items which are required to produce milk. The same is true of the percentages given as representing the part of the total cost which was offset by the credits allowed for calves and manure. The percentages are influenced not only by the variation in costs, but also by the values allowed for calves and manure and the amount of manure credited to the herds.

PRESENTATION OF RESULTS BY MONTHS, SEASONS, AND YEARS.

The variation in the monthly feed cost during any one of the seasons in either year was not large. In most cases the variations, as shown in Tables 15 and 16, are no more than might naturally occur on account of local conditions, such as a fluctuation in the price of feed or weather conditions. The reason why the November feed cost of each year was lower than for the other winter months probably is that during that month some of the herds were allowed to run in the fields that had been in crops, in order that scattered feed might be kept from going to waste. Some of the dairymen were later than others in beginning to feed their regular full winter rations.

The cost of feed other than pasture fluctuates from month to month in the summer, and the same is true of the cost of pasture, but when these two costs are combined the variation in the total monthly feed and pasture cost is no more than occurred in the winter months. In distributing the pasture cost over the summer seasons the amount of grass furnished by the pastures each month was estimated and the total season's charge for pasture distributed accordingly. The following per cents were used for both years: May, 15 per cent; June, 33 per cent; July, 20 per cent; August, 10 per cent; September, 12 per cent; and October, 10 per cent. Since the records have been compiled it appears that these figures must have been fairly accurate, for wherever a heavy charge for pasture was made the amount of other feed consumed was comparatively small.

TABLE 15.—*Feed and labor requirements, by months, for producing milk during the winters of 1915–16 and 1916–17.*

WINTER 1915–16.

Month.	Cows.	Milk sold and used.	Income from milk sold and used.	Income per 100 pounds, less freight charge.	Concentrates fed.		Dry roughage fed.		Succulent roughage fed.		Total feed cost.	Labor.	
					Cost.	Quantity.	Cost.	Quantity	Cost.	Quantity.		Total human.	Total horse.
		Pounds.				*Pounds.*		*Pounds.*		*Pounds.*		*Hours.*	*Hours.*
November	353	186,859	$3,575.88	$1.91	$798.24	65,838	$385.34	98,241	$393.30	192,000	$1,576.88	4,792.2	471.7
December	345	189,791	3,652.17	1.92	1,004.59	88,009	612.06	148,982	637.21	318,600	2,253.86	5,150.7	487.6
January	336	189,211	3,522.06	1.86	1,129.25	90,065	649.64	134,083	641.23	316,292	2,420.12	5,455.0	487.3
February	331	185,098	3,318.43	1.79	931.35	70,412	561.14	116,055	648.50	322,216	2,140.99	4,848.8	508.2
March	319	198,222	3,492.05	1.76	1,211.57	90,446	560.62	109,348	621.18	308,576	2,393.37	5,135.7	561.2
April	326	190,550	3,372.76	1.77	1,074.84	76,629	661.53	127,140	577.26	288,630	2,313.63	4,717.1	593.7
Total	335	1,139,731	20,933.35	1.84	6,149.84	481,399	3,430.33	733,849	3,518.68	1,746,314	13,098.85	30,099.5	3,109.7

WINTER 1916–17.

November	408	215,310	$4,957.12	$2.30	$1,114.04	74,470	$788.52	171,180	$724.95	345,376	$2,627.51	5,714.2	483.2
December	413	239,129	5,951.29	2.49	1,361.59	90,326	1,029.57	212,123	742.48	371,192	3,133.64	6,505.6	648.5
January	411	257,122	5,559.81	2.16	1,511.56	93,273	959.30	192,592	809.46	394,504	3,280.32	6,592.9	649.2
February	407	249,594	5,159.18	2.07	1,526.13	85,323	865.60	158,832	662.83	341,413	3,054.56	6,112.3	564.5
March	397	266,337	5,249.84	1.97	1,839.46	96,245	858.38	145,872	738.86	368,502	3,436.70	6,311.4	582.3
April	394	252,456	6,418.36	2.54	1,868.47	89,674	946.81	135,934	596.76	298,380	3,412.04	5,361.7	541.6
Total	405	1,479,948	33,295.60	2.25	9,221.25	529,311	5,448.18	1,016,533	4,275.34	2,119,367	18,944.77	36,598.1	3,469.3

TABLE 16.—*Feed and labor requirements, by months, for producing milk during the summers of 1915–16 and 1916–17.*

SUMMER 1915–16.

Month.	Cows.	Milk sold and used.	Income from milk sold and used.	Income per 100 pounds, less freight charge.	Concentrates fed.		Dry roughage fed.		Succulent roughage fed.		Total feed cost other than pasture.	Pasture cost.	Total feed and pasture cost.	Labor.	
					Cost.	Quantity.	Cost.	Quantity.	Cost.	Quantity.				Total human.	Total horse.
		Pounds.				*Pounds.*		*Pounds.*		*Pounds.*				*Hours.*	*Hours.*
May	325	201,275	$3,168.22	$1.57	$534.19	38,424	$65.94	10,828	$274.59	101,294	$874.72	$588.63	$1,463.35	4,131.9	532.6
June	328	196,110	2,765.66	1.41	214.82	16,505	3.38	450	160.56	80,280	378.76	1,294.96	1,673.72	4,038.8	522.5
July	328	183,207	3,151.07	1.72	355.63	26,861	179.87	40,839	138.23	69,116	673.73	784.82	1,458.55	4,321.4	577.6
August	330	177,480	3,210.36	1.81	542.01	42,131	417.47	94,100	253.28	126,643	1,212.76	392.41	1,605.17	4,188.2	429.5
September	343	193,332	3,401.32	1.76	678.87	51,474	153.93	38,405	219.82	109,760	1,052.62	470.89	1,523.51	4,102.1	424.2
October	338	202,456	3,494.17	1.72	759.69	57,485	148.10	25,922	281.06	164,183	1,188.85	392.40	1,581.25	4,401.6	420.6
Total	332	1,153,860	19,190.80	1.66	3,085.21	232,880	968.69	210,544	1,327.54	651,276	5,381.44	3,924.11	9,305.55	25,184.0	2,907.0

SUMMER 1916–17.

May	394	259,484	$5,388.83	$2.08	$1,138.69	50,679	$466.13	70,086	$306.09	153,053	$1,910.91	$553.12	$2,464.03	5,135.8	404.2
June	398	244,188	4,332.79	1.77	527.80	23,147	53.85	6,980	101.00	50,500	682.85	1,216.88	1,899.53	4,482.5	367.8
July	402	231,737	5,274.33	2.28	698.60	32,023	403.93	65,986	209.95	104,976	1,312.48	737.46	2,049.94	4,667.2	422.9
August	401	193,551	4,745.30	2.45	714.01	32,304	736.23	114,066	149.96	74,975	1,600.20	368.73	1,968.93	4,622.2	402.1
September	410	202,537	3,750.51	1.85	873.07	60,928	406.32	96,266	456.39	210,557	1,735.78	442.49	2,178.27	5,063.0	428.8
October	412	211,101	4,543.05	2.15	1,058.83	66,144	618.28	119,927	510.14	255,079	2,187.25	368.72	2,555.97	5,479.1	472.1
Total	402.8	1,342,598	28,034.81	2.09	5,011.00	265,225	2,684.74	473,311	1,733.53	849,140	9,429.27	3,687.40	13,116.67	29,449.8	2,497.9

The "overhead and other costs" are not shown by months. Since they were prorated evenly over the months in each season, and since there was no definite fluctuation in the production of milk by months, these costs per 100 pounds would be approximately the same throughout the season. Table 17 does not include cost of feed and labor, but only the overhead and other costs which have not been previously itemized.

TABLE 17.—*Capital invested and overhead and other charges against buildings, equipment, and herds.*

Item.	Winters.	Summers.	Two years.	Per cent of inventory value.
Buildings:				*Per cent.*
Inventory	$53,305.06	$53,288.96	$53,297.01	
Charges:				
Interest	1,332.64	1,332.24	2,664.88	5.0
Depreciation	1,105.77	1,105.43	2,211.20	4.1
Taxes	129.79	129.75	259.54	.5
Insurance	91.22	91.19	182.41	.3
Upkeep and repairs	386.71	386.60	773.31	1.5
Total charges	3,046.13	3,045.21	6,091.34	11.4
Equipment and supplies:				
Capital invested	10,546.18	10,546.18	10,546.18	
Charges:				
Interest	316.39	316.39	632.78	6.0
Taxes	5.76	5.76	11.52	.1
Depreciation	1,002.88	1,002.88	2,005.76	19.0
Repairs	87.17	87.17	174.34	2.6
Milking-machine repairs	49.45	49.45	98.90	
Total charges	1,461.65	1,461.65	2,923.30	27.7
Herds:				
Capital invested	62,975.00	62,975.00	62,975.00	
Charges:				
Interest	1,889.25	1,889.25	3,778.50	6.0
Depreciation	441.75	441.75	883.50	1.4
Taxes	289.76	289.76	579.52	.9
Insurance	97.18	97.18	194.36	.3
Total charges	2,717.94	2,717.94	5,435.88	8.6
Total overhead and other charges against buildings, equipment, and herds	7,225.72	7,224.80	14,450.52	11.4

SUMMARY.

In the production of market milk in those dairies under observation the various cost and credit factors, except cost of management, bore the following relation to the total cost of production: Feed and pasture, 57.6 per cent; labor, 19.5 per cent; overhead and other costs, 22.9 per cent. The total cost was offset 22.3 per cent by calves and manure.

The unit requirements for keeping a cow one year were: Concentrates, 1.02 tons; dry roughage, 1.65 tons; silage and other succulent roughage, 3.64 tons; hauling and grinding concentrates, $1.53; bedding, 0.36 ton; pasture, 1.36 acres; human labor, 164.5

hours; horse labor, 16.2 hours; overhead and other costs, $27.11. Credits other than milk: Manure, 6.8 tons; calves, 0.87.

Interest, depreciation, and similar items on buildings amounted to 11.4 per cent of their inventory value. Corresponding charges against equipment were 27.7 per cent of the equipment inventory, and the herd charges were 8.6 per cent of the herd inventory. The total charges against buildings, equipment, and livestock amounted to 11.4 per cent of their combined inventory value (see Table 17).

Men performed 84.7 per cent of the work about the dairy in winter, but in summer only 80.7 per cent of it. The rest of the labor was performed by women or boys and girls.

The net cost of producing 100 pounds of milk was 1.8 per cent higher from November to April, inclusive, than during the period of May to October, inclusive, and the total cost varied only slightly from month to month during any one season. A little more labor was required to produce 100 pounds of milk in the winters than in the summers.

There was no close correlation between the monthly cost of milk and the monthly price received for it during the two years.

The proportion of cows which freshened each season was uniform, and the calf crop was divided equally between the winter and the summer periods.

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